Manufacturing Readiness Review (MRR)
Test Readiness Review (TRR)

GLAST Crystal Detector Element (CDE) Manufacturing Readiness Review (MRR)

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Prepared for:

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Space Science Division
Code 7651
Washington, DC 20375

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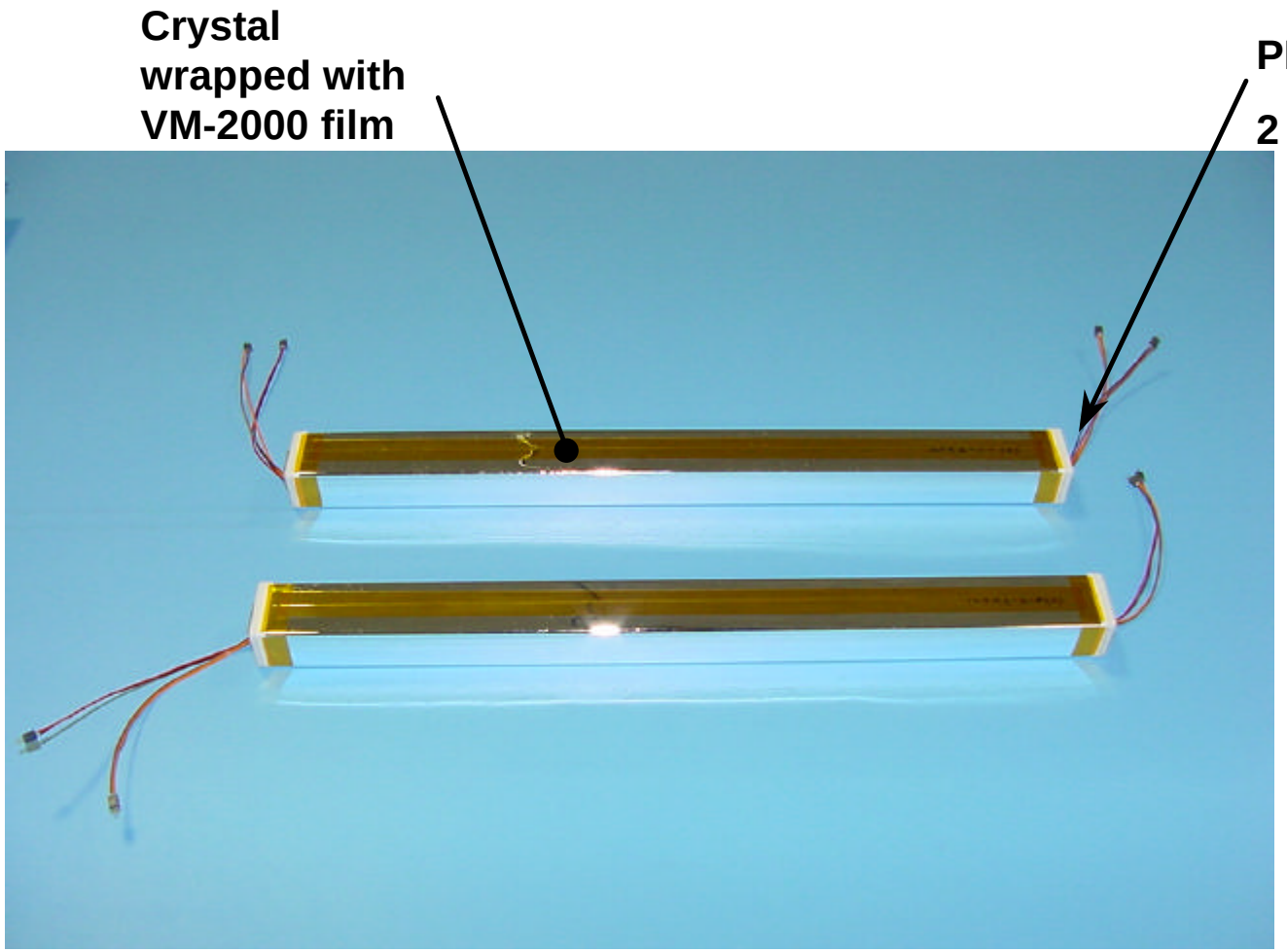
Agenda

- CDE Assembly Program Overview
- Documentation
- Manufacturing Flow
- Risk Reduction Activities
- Facility
- Tooling
- Parts Status
- In-Process Testing
- Shipping & Handling

CDE Assembly Program Overview

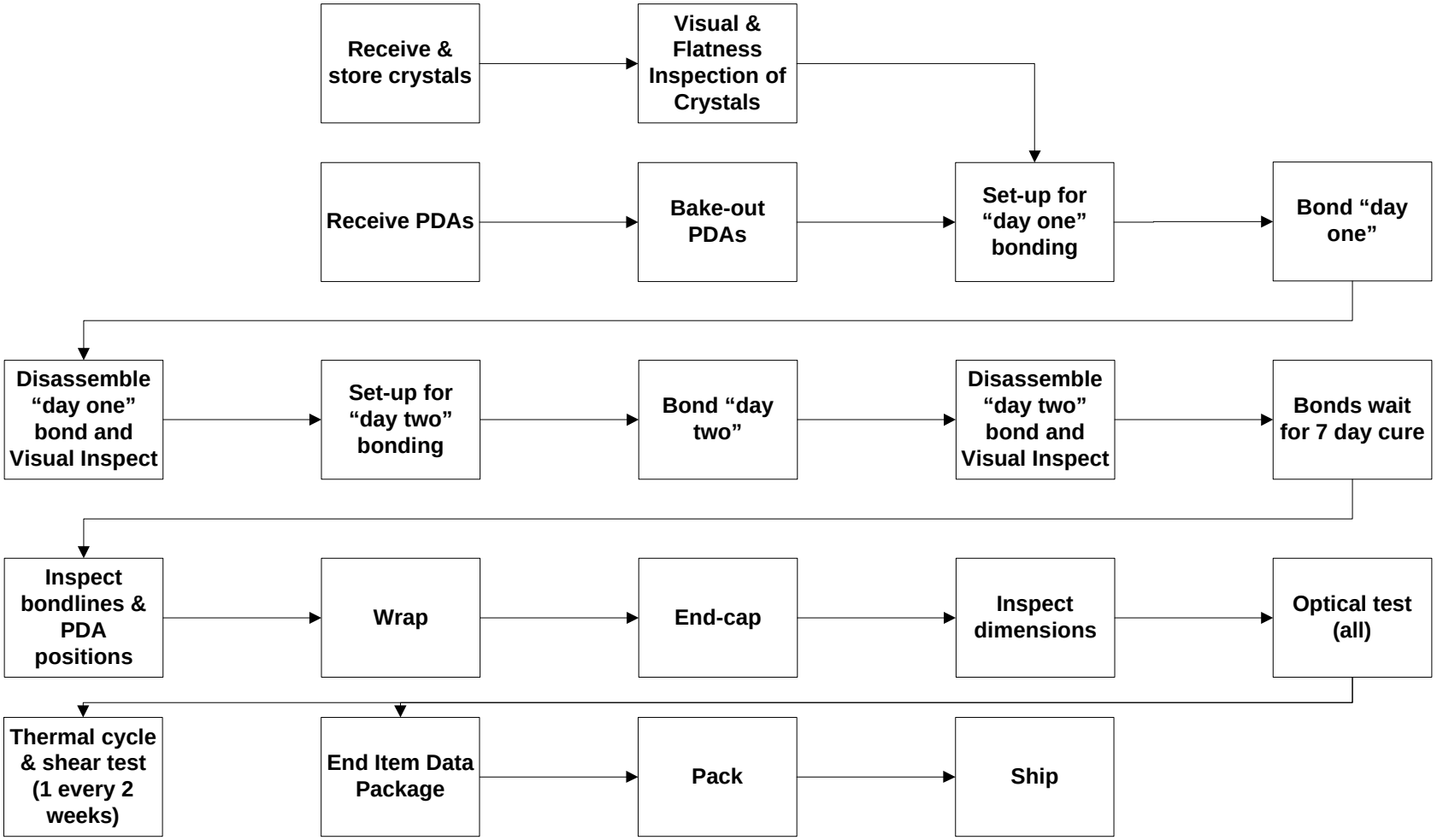
- **Bond & test 1920 Flight CDE assemblies**
  - 64 assemblies per week
  - PDAs, Crystals, VM-2000 film, and End Caps supplied by NRL
  - Tooling proven-out in Development and Pre-Qualification
  - Released documentation
    - CM controlled
  - Acceptance Test per LAT-SS-02235-02
    - Visual
    - Mechanical
    - Optical
- **Expect Flight bonding to start December 2003**
  - Tooling complete
  - Facility on-line
  - Team in place
  - Paperwork in place (less Shipping & Optical Test procedures)
  - PDA is driving start of Flight Bonding

CDE Photograph



2 CDE ASSEMBLIES SHOWN

Manufacturing Flow Diagram



- **Show Slides**

Documentation

- **Processes**
  - Crystal Handling, SAI-PROC-1231, Rev A
    - Release 03 September 2003
  - PDA Handling, SAI-PROC-1232, Rev -
    - Release 03 September 2003
  - ESD Handling, SAI-PROC-1233, Rev -
    - Release 03 September 2003
  - Bonding, SAI-PROC-1229, Rev -
    - Release 03 September 2003
  - Wrap & Cap, SAI-PROC-1234, Rev -
    - Release 03 September 2003
  - Shear Strength Test, SAI-PROC-1250,
    - Release 29 October 2003
  - CDE Packaging and Shipping, SAI-PROC-1266
    - Expected Release 14 November 2003
  - CDE Light Testing, SAI-PROC-1267
    - Expected Release 14 November 2003
- **Drawing**
  - CDE Assembly, LAT-DS-01900, Rev -
    - Release 02 October 2003
- **Travelers**
  - PDA Bake-Out, Rev -
    - SAI-TRAV-4329
    - Available for CM release
  - Wrapper Cutting & Forming, Rev -
    - SAI-TRAV-4302
    - Available for CM release
  - CDE Assembly, Rev A
    - SAI-TRAV-4297
    - Available for CM release
  - CDE Light Testing, Shear Testing, Packaging and Shipment
    - SAI-TRAV-4397
    - Expected release date 17 November 2003
      - Waiting on light testing of 12 engineering model CDEs

Typical Weekly Build Plan (64/Week Average)

Monday, Week 1	Tuesday	Wednesday	Thursday	Friday
Hour 8-4	Hour 8-4	Hour 8-4	Hour 8-4	Hour 8-4
Bond 48 pcs. (A)	Form wraps	Dissassemble & Bond 48 pcs. (B)	Form wraps	Dissassemble & Bond 48 pcs. (A)
Form wraps		Form wraps		Form wraps
				48 assemblies bonded complete
Monday, Week 2	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Dissassemble & Bond 48 pcs. (B)	Form wraps	Dissassemble & Bond 48 pcs. (A)	Form wraps	Dissassemble & Bond 48 pcs. (B)
Form wraps		Form wraps		Form wraps, inspect, wrap & cap
		96 assemblies bonded complete		Waited for 7-day cure prior to wrap & cap
Monday, Week 3	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Dissassemble & Bond 48 pcs. (A)	Inspect, wrap & cap, light test	Dissassemble & Bond 48 pcs. (B)	Inspect, wrap & cap, light test	Etc…
Inspect, wrap & cap, light test		Inspect, wrap & cap, light test		
144 assemblies bonded complete				192 bonded. 192/3 weeks = 64 per week.

Risk Reduction Activities to Date

- **Post- Engineering Model activities**
  - Tooling and bond processes refined and documented
  - Revised tooling
    - Utilized lessons learned
    - Changed mold material (Teflon to aluminum with mold release)
    - Removed O-rings
    - Simplified supports
    - Loosened tolerances on masks and seals
    - Simplified mask (Made clamp a separate aluminum part)
    - Simplified workbench
  - Bond training
    - 36 bonds on various Crystal and PDA configurations
    - Train new technicians
- **Flight development units**
  - Bonded 4 CDE assemblies with flight-like tooling
- **12 Pre-Qualification CDEs**
- **12 Mini-EM CDEs (Flight configuration for Mini-EM calorimeter)**

Risk Reduction Activities - Planned

- **Continue training technicians with Flight tooling and Flight-like materials**
  - Will continue up until start of Flight effort
- **Build 48 non-Flight units to Flight schedule**
  - Build
    - Use aluminum Crystal mock-ups
    - Use Flight prototype PDAs
      - Use PDAs fabricated to pipe-clean the PDA assembly process
      - Flight-like End Caps
    - Flight tooling
  - Inspect
  - Pack & Ship (including all paperwork)
  - Purpose:
    - Verify we can build to production rate
    - Troubleshoot logistics to support build rate
    - Revise paperwork as-required with lessons learned

Training/Certification

	Electrostatic Discharge Control NASA-STD-8739.7	Polymerics NAS-STD-8739.1	Bonding PDAs to Crystals SAI-PROC-1229	Wrapping and End Cap Assembly SAI-PROC-1234	Handling of Crystals SAI-PROC-1231	Handling of PDAs SAI-PROC-1232	ESD Handling SAI-PROC-1233	Strength Testing of the CDE SAI-PROC-1250	Light Testing SAI-PROC-1267
TECHNICIANS									
Tony Baltusis	exp. 6/12/04	exp. 5/15/04	TRAINED	TRAINED	TRAINED	TRAINED	TRAINED	N/A	N/A
Doug Ng	exp. 7/25/05	exp. 1/16/05	TRAINED	TRAINED	TRAINED	TRAINED	TRAINED	N/A	N/A
Gary Sheridan	exp. 6/5/05	exp. 3/01/04	TRAINED	TRAINED	TRAINED	TRAINED	TRAINED	N/A	N/A
Jim Weinreich	exp. 7/25/05	exp. 1/16/05	TRAINED	TRAINED	TRAINED	TRAINED	TRAINED	N/A	N/A
Gabriel White	11/14/2003	11/14/2003	11/14/2003	11/14/2003	11/14/2003	11/14/2003	11/14/2003	N/A	N/A
Tammy Turner	N/A	N/A	N/A	N/A	11/14/2003	N/A	11/14/2003	11/14/2003	N/A
QUALITY									
Brian Martini	exp. 8/20/05	exp. 5/15/04	11/14/2003	11/14/2003	11/14/2003	11/14/2003	11/14/2003	11/14/2003	11/14/2003
Don Brown	exp. 6/5/05	11/14/2003	11/14/2003	11/14/2003	TRAINED	TRAINED	TRAINED	11/14/2003	11/14/2003
SUPERVISOR									
John Haggerty	exp. 6/05/05	11/14/2003	TRAINER	TRAINER	TRAINER	TRAINER	TRAINER	TRAINER	11/14/2003

Facility

- **Temperature**
  - 20º to 30 º C
- **Humidity**
  - 30 % to 50 % RH
  - 50% to 55% for 3-hour maximum
- **Cleanliness**
  - Class 100,000 cleanroom
  - Caps, gowns & shoe covers required
    - Gloves & face masks when working with hardware
- **ESD**
  - Certified grounded workstations (benches)
  - Floor mats
- **Natural Light Screening (Tinting on clean room windows)**
  - 99% UV
  - 65% Optical

Tooling

- **50 sets of Flight bond tools (48 plus 2 spares)**
  - 50 sets complete
  - 140 Masks & seals
    - Enough for 280 CDEs
    - Next 400 prior to Flight start-up
      - Enough for 800 CDEs
    - Remainder in lot deliveries
  - Bench complete
  - Wrapper form tooling in place
  - Improved wrapper fixture in place
  - End Cap tooling in place
  - Inspection Tooling
    - Go/No Go Gages not complete
      - Inspection can be performed with standard inspection tools, gages for process streamlining only

Parts

- **Customer Furnished**
  - Crystals
    - Approximately 500 Flight Crystals at NRL
    - Swales ready to accept shipment
  - PDAs
    - Waiting on Flight PDAs from NRL
    - Expect first delivery in early December 2003
  - End Caps
    - 50 non-Flight End Caps at Swales
    - Flight End Caps due late November 2003
  - VM-2000 Film
    - 4 rolls at Swales (enough for Flight build)
- **Swales- supplied, all in-house**
  - Primer
    - DC 92-023
    - Enough primer for entire build
  - Adhesive
    - DC 93-500
    - Enough adhesive for approximately 50% of Flight build
  - Kapton Tape, 2-1/2 mil thick, acrylic adhesive
    - 3/8” wide
    - ½” wide

Acceptance Testing

- **Visual inspection**
  - At Swales
- **Dimensional**
  - At Swales
- **Thermal cycling and shear testing**
  - 1 CDE every 2 weeks
  - Location Swales
- **Optical testing**
  - Every CDE tested in Muon telescope
  - At Swales

Non-Conformances

- **All Swales non-conformances are documented per SAI-OP-013-001 (NCR)**
- **If cannot be reworked to print, and MRB required:**
  - Required signatures:
    - Manufacturing Engineer
    - Manufacturing Area Manager
    - Quality Engineer
    - Swales Program Manager
    - NRL Program Representative
- **Cause and Corrective Action tracked per SAI-OP-014-001**

Shipping and Handling

- **All crystals and CDE assemblies to be handled on carriers**
- **All crystals and CDE assemblies to be stored on flat aluminum rack**
  - In vapor-barrier bags with desiccant and humidity indicator
    - ESD bag material
- **Shipping**
  - CDEs to be shipped in shipping holders and existing cases
  - Swales to ship with DD-1149
    - Swales truck
      - Direct delivery

In Emergency, Call …

- **Team members have access to support at all times**
  - **John Haggerty** (Product Engineer, Build Supervisor) – (410) 775-9991 (home)
  - **Jimmy Lee** (Quality Engineer) – 202-404-1476 (NRL office), 301-237-8871 (cell)
  - **Brian Martini** (Quality Engineer) – 202-404-1435 (NRL office), 1-888-735-5940 (pager)
  - **Nick Virmani** (Quality Manager) – 202-767-3455 (NRL office), 301-902-4344 (Swales Office) 1-888-950-7615 (pager)
  - **Mike Kennedy** (Swales Program Manager) – (443) 994-1003 (cell)
  - **Eric Grove** (NRL Program Scientist) – 202-767-3112 (NRL office), 202-297-4467 (cell)
  - **Bill Raynor** (NRL Program Manager) – 202-404-1461 (NRL office), 1-888-596-7792 (pager)